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ABSTRACT

Students could gain considerable insight into the philosophy and methods of scientific experimentation if instructors adopted procedures based on an understanding of and respect for writing as a process. Laboratory courses in psychology offer such an opportunity. These courses usually involve a heavy workload for both students and faculty, for, in addition to studying the regular course material, students attend a weekly laboratory in which they are taught experimental design and procedure, laboratory control, ethical considerations for psychological research, library research procedures, and preparation of manuscripts in appropriate American Psychological Association (APA) style and format. In one laboratory course, students are responsible for turning in two separate, completed manuscripts. After a first draft, the instructor and lab assistant meet with each student in individual conferences to review first drafts. The first draft is then returned to the student for revision. The final draft, due about a week later, is reviewed and graded by the instructor alone. Students are instructed to emphasize organization and content in their first drafts and not to pay too much attention to editing and minor format considerations. First drafts are never graded; rather, students receive only praise and constructive criticism. The use of multiple drafts helps students to learn a new writing style and to understand the material they are writing about. An evaluation of the course shows the students like the multiple draft method. They perceive the benefits as being substantive--internal as well as external revision takes place. (HOD)

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Multiple Drafts of Experimental Laboratory Reports[1]

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Writing is a process. It is more than what appears on paper as the finished product of an author's thoughts and cognitions. It includes these cognitions as well as the discoveries which occur as the writer reads and modifies his or her earlier products. Cooper and Odell (1977) in the introduction to their important book on the evaluation of writing identify writing processes in the following terms:

> Composing involves exploring and mulling over a subject; planning the particular piece (with or without notes or outline); getting started; making discoveries about feelings, values, or ideas, even while in the process of writing a draft; making continuous decisions about diction, syntax, and rhetoric in relation to the intended meaning and to the meaning taking shape; reviewing what has accumulated, and anticipating and rehearsing what comes next; tinkering and reformulating; stopping; contemplating the finished piece and perhaps, finally, revising. This complex, unpredictable, demanding activity is what we call the writing process. Engaging in it, we learn and grow (pg xi).

Donald Murray (1978) explains that writing consists of three phases which he calls prevision, vision, and revision. Prevision includes the experiences, research, observations, and awareness which come before the first draft. It begins the process of identifying and limiting the subject. Vision is the first (or what Murray calls the "discovery") draft. Revision is what the author does to modify the first draft. It includes developing and shaping the early ideas and meanings which result from the vision.

Murray further expands his ideas about revision processes by identifying two separate acts. First he talks about internal revision, or the discovery and development of ideas by the writer. Internal revision begins with the reading of the first draft and the gradual understanding of the focus, purpose, and actual information which he or she is trying to convey. External revision, on the other hand, consists of the processes which the writer uses to communicate to the audience. It is the way the outcome of the internal revision is presented, and consists of choosing format, refining language, proofreading, etc. According to Murray, the internal revision processes are, by far, the more important. Most successful writers spend a considerable amount of their time in internal revision.

[1] Parts of the information contained in this chapter will be presented at the Ninetieth Annual Convention of the American Psychological Association, Washington, D.C. 1982.

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So writing helps the writer as well as the audience to understand. A writer uses writing to clarify and gain insight into the information he or she is trying to convey. Professional writers know this well. Many novelists and poets have established their own special procedures for prevision, vision, and revision processes. They have developed ways to understand their own thoughts and focus them during the course of writing. Most scientists, on the other hand, have probably not given much thought to the writing process itself. Their primary purpose in writing is to convey their research findings to professional colleagues; they tend to emphasize the empirical research rather than the writing itself. My own informal survey of fellow behavioral, social, and natural scientists indicates that writing is not commonly associated with thought processes and insight. Only a few scientists consciously use writing as a tool to clarify their own thoughts.

To me this is unfortunate, for much insight is to be gained through writing. As I reread this attempt to introduce the scope and content of my chapter, I am struck by the dramatic differences between this product and my earlier attempts. As I have changed the words which appear on the page, my focus has changed as well. There has been a constant interaction between process and product from which has evolved the present manuscript. The earlier ones no longer say what I think they should. And I suspect that this one will not seem appropriate tomorrow.

All of us who are responsible for the intellectual growth of our students are looking for ways to improve their understanding and appreciation of the material we present to them. Laboratory courses in the behavioral, social, and natural sciences are designed with the hope that the hands-on experiences of the students are important enough to their education to deserve the extra time and effort which both faculty and students must expend. Students in these courses are usually required to do many of the things which a scientist in that area does on a regular basis. These often consist of designing experiments, completing literature reviews, collecting and analyzing data, and writing in manuscript form the history, procedure, results and conclusions of the experimental studies. We expect that, as a result of their effort, students will have a better understanding of what a scientist does.

But we seldom pay much attention to the writing processes of our students. Science faculty could use lab reports as a technique to help students understand their experiments. It is my thesis in this chapter that students could gain considerable insight into the philosophy and methods of scientific experimentation if the instructors adopted procedures which many of our colleagues in English have been using in their composition instruction, procedures which are based on an understanding and respect for writing as a process.

My Use of Multiple Drafts

As an experimental psychologist I often teach laboratory courses in psychology. These experimental lab psychology courses usually involve a heavy workload for both students and faculty, for, in addition to the regular course material, students attend a weekly laboratory in which they are taught experimental design and procedure, laboratory control, ethical considerations for

psychological research, library research procedures, and preparation of manuscripts in appropriate American Psychological Association (APA) style and format. In the courses I teach, part of the laboratory consists of "hands-on" experience in psychological research in which students participate in experiments which I design. The students are responsible for statistical analysis of the data, library research, and a completed manuscript containing all the appropriate sections of an APA paper.

Prior to spring semester 1981, I usually required in my experimental laboratories three experiments; students were responsible for turning in three separate completed manuscripts. I then made comments on the manuscripts, graded them, and returned them. But I found that, particularly in the first manuscript or two, frequent problems emerged. Most students had not written manuscripts of psychological experiments before or used APA style and format. They were unclear about some of what was expected, and their writing reflected their problems. Therefore, I decided to turn to some of the suggestions of my English colleagues and adopt a somewhat different procedure regarding experimental manuscripts. Beginning in the spring semester of 1981 I reduced the number of experiments which students had to complete from three to two and required two drafts of each of the two manuscripts. It was my hope that students would benefit from the first draft feedback in their understanding of the purpose, procedure, and content of the experiment.

For the first three semesters in which I required multiple drafts, I collected the first draft of the paper (I will call it a first draft, but many students have already completed some revision by this time), then reviewed it and made comments. A graduate student teaching assistant also reviewed it independently. The first draft was then returned to the student for revision. The final draft, due about a week later, was reviewed and graded by me alone and returned to the student. There has been one significant change in my multiple drafting procedure. Last spring, rather than collecting the manuscripts for review, the lab assistant and I met with each student in individual conferences to review first drafts. During these conferences the students read the papers and the assistant and I interrupted to make comments where we deemed appropriate. These conferences commonly took about 20 to 25 minutes.

This "personal conference" procedure has a couple of important advantages over our earlier procedure of collecting and reviewing the manuscripts. First of all, manuscripts are not kept out of students' hands. Students can make use of the feedback while the content of the first draft is still fresh in their minds. In addition, personal conferences allow for closer interaction among the student, lab assistant and me; a more dynamic process of review occurs. Each of us can understand better the motives and rationale of writing and drafting in a face-to-face situation. The student receives a more dynamic form of feedback which goes beyond a series of static words on a sheet of paper.

I have established several guidelines and rules of thumb for the use of multiple drafts in my experimental psychology labs. First, I instruct students to emphasize organization and content in their first drafts and not to pay too much attention to editing and minor format considerations. These latter types of

revisions (Murray's external revisions) should be saved for later drafts. The process of drafting involves successive revisions coming progressively closer to the ideal product. I feel it's important that the student understand that overemphasis on the minor points of wording and format in early drafts will help them less than concentrating on the main content of the paper.

Second, the first drafts turned in are never graded; students receive only praise and constructive criticism. Only the final draft receives a grade, and this grade is not at all influenced by first-draft quality. I do, however, require that a first draft be submitted; it is not an optional exercise. A record is kept of students who fail to submit a first draft, and the final course grade reflects this failure.

Third, students are never belittled for the quality of their first drafts. Comments are made to help the students understand the study and improve their manuscripts. I attempt to provide a direction for revision and to help instill in the students a belief that they have the competence to carry out the revision.

In a similar vein, neither the laboratory assistant nor I will "write" any of the manuscript for any student. We will make suggestions about ways in which information might be stated, point out what needs to be changed, and identify errors of omission and commission, but the final product is the result of the student's own writing processes. The student understands that we are there to facilitate, not substitute.

Finally, students are aware that the amount of feedback they receive depends on the effort they make. A student who does not attempt to write an introduction gets no help in writing one. If a student types his or her first draft, we will make comments on the appearance and format of the manuscript, but handwritten manuscripts will receive no such feedback. Thus, the more complete the first draft, the more complete the feedback.

These guidelines have evolved over the course of my use of multiple drafting. They are ideas and procedures that I am comfortable with, and I feel that they help students use multiple drafting in a constructive way. Students should not only better understand the experiments but should become aware of their own writing processes as well.

Evaluation of Multiple Drafts

My impression of the use of multiple drafts has been that they are beneficial to the student in learning a new writing style and format and in understanding the material they are writing about. I have felt since I have been requiring multiple drafts that student manuscripts were perhaps a little better a little sooner than manuscripts which were submitted just once. I also have felt that students have appreciated the opportunity for interim feedback and probably worked a little harder as a result. But, empiricist that I am, I decided to investigate by means of a questionnaire the value that students put upon the multiple draft procedure. I also compared laboratory report grades of multiple draft and single draft papers.

With the aid of Dr. Robert Holt of the Psychology Department, I constructed a questionnaire which was submitted to the students during the last week of the semester. The questionnaire was answered anonymously, and students were assured that the completed forms would be sealed and unavailable to me until course grades had been assigned. Questions dealt with prior experience with multiple drafts in other courses, time and effort expended on each draft, types of revisions made after first-draft feedback, quality of the feedback, and student evaluation of the overall process. Most questions were answered either by rating on a 1-7 scale or by filling in numbers on the form. There were, however, three open-ended questions by which students could give overall evaluations.

I administered the questionnaire twice, once at the end of the first semester in which multiple drafts were required and once at the end of the semester in which I held conferences to give students first-draft feedback. Responses to the two administrations of the questionnaire were, overall, very similar. Let's look at the results in some detail.

The students' evaluations were very positive; in fact, "ecstatic" or "thrilled" might better describe their responses. Combined across two questions and questionnaire administrations, 71 out of 98 responses regarding the overall evaluation of multiple drafts fell in the highest of seven categories. Only three responses were placed in the lowest four (including the neutral) categories. To another question, 41 out of 42 students rated the multiple draft method more helpful than single draft (the other student rated them equal), and 34 of the 41 indicated that multiple drafts were much more, as opposed to somewhat more or slightly more, helpful. Results like these are an empiricist's dream!

Responses to the open-ended questions also occasionally gushed with praise of multiple drafts ("It was great!" "Don't change a thing!"). But they also helped clarify some of the reasons why students were so positive in their evaluations. Many students responded that they were better able to learn from their mistakes using multiple drafts and that they could avoid unnecessary errors. Several students also cited less pressure and increased confidence in their products as a result of first-draft feedback. Several others stressed the value of multiple drafts when writing in a new style and format. Finally, a few students said that, particularly with some time off between drafts, a clearer and more thoughtful presentation of ideas was possible and new insights could develop during the process of redrafting. This final point is what writing researchers have been saying about the writing process all along!

The only recurring negative comment about the use of multiple drafts was the increased time required to reach a finished product. Several students felt that requiring two submissions put too much of a burden on them. Two or three students suggested making first-draft submission optional. This criticism reminds us that where multiple drafting is being used in a classroom fewer papers should be required. A student should benefit more in learning to write from two submissions of a single paper than one submission of two separate papers. Therefore, the faculty member should reduce the overall number of paper assignments.

Only one other criticism was cited by more than one student: writing multiple drafts is boring. Rewriting the same information several times is less exciting and produces a loss of interest faster than writing about different issues. But even with this criticism, one student indicated that new insights into the same material could be exciting as well.

Thus, students cited many positive and few negative thoughts about multiple drafting. My early impressions of the process of drafting were supported by the students' views. They recognized the benefits that writing researchers have attributed to multiple drafts for many years.

The questionnaire also revealed one other important aspect of multiple drafts: the revisions were usually substantive and not merely editorial in nature. Two of the questions asked students what types of changes they made as a result of feedback: mechanical (spelling, punctuation, word tense, etc.), wording (substituting one word for another), phrasing (rewording and restructuring sentences), and idea (changing concepts and ideas). Responses in both semesters were clear: whether measured in amount of time spent in revision or percent of changes made, about two thirds of the changes consisted of phrase and idea rather than mechanical or wording changes. In other words, students perceived that the feedback helped them in their writing before it reached the editorial stage.

Thus, overall, students perceived the multiple draft method as very positive in helping them prepare quality reports. Furthermore, they perceived the benefits as being substantive. Internal as well as external revision took place.

Student Benefits

The final criterion of any classroom procedure is its benefit to the student: what does he or she learn as a result. What is the pedagogical value of a multiple draft procedure? While most of the answer to this question must be based on speculation, we can begin to answer it by looking at grades of laboratory reports.

The lab report grades could be compared in a number of ways. We could, for example, compare the grades assigned on the first reports of students in labs which did not use multiple drafting to those of students in the multiple-drafting sections. This would show us whether there was any immediate benefit in the use of multiple drafts. However, it would not equate for number of "submissions" or number of times feedback was received by the student. For this we would need to compare the second paper from classes where only a single draft of each report was submitted with the first paper from class in which students received feedback on their first drafts. Finally, we could compare the final lab reports of single and multiple-draft students.

I made all these comparisons. Table I shows the frequencies of A, B, C, and D-F grades (ignoring + and - scores) by students in the spring 1979 and 1980 labs (single drafts only) and those in the spring 1981 and 1982 labs (multiple drafts).

Table I. Grade distributions on laboratory reports. The 79-80 frequencies are those of students who turned in only one draft; 81-82 students used multiple drafting.

	1st Report		2nd Submission		Final Report	
Grade	79-80	81-82	79-80	81-82	79-80	81-82
A	7	15.5	12.5	15.5	23	22.5
B	16	19	18	19	15.5	18.5
C	32	19.5	17.5	19.5	13.5	8
D-F	4	0	7	0	3	0

The .5 frequencies occurred because a few students were assigned grades (e.g., B-/C+) which spanned two categories.

The table suggests that students become proficient at writing lab reports more quickly using multiple drafts, but that the difference diminishes over the course of the semester. A statistical comparison shows that the distribution of grades was significantly higher for multiple draft students on the first report and on the second "submission" but the distribution of final report grades for single - and multiple-draft students was well within chance range.

We need to recognize that drawing conclusions from the distribution of lab report grades is risky business from an empirical point of view. At least three procedural problems exist which must temper our confidence in any such conclusions. First, the reports spanned four different semesters, and the equivalence of student abilities, background, and motivation could not be ensured. My impression was that the four classes were comparable, and midterm and final examination grades were similar across semesters. Nevertheless, no way of equating the students on bases like ability and experience was possible.

Second, over the course of the three-year span, my grading criteria and many other aspects of the course may have changed. The changes mean that more than the drafting procedure was modified. Any improvement in performance may well have been due in part to changes in the course other than the adoption of a multiple drafting procedure.

Third, there was no independent and blind evaluation of the laboratory reports. I was both instructor and researcher, and my biases about multiple drafts may have influenced my assignment of grades. Ideally, different evaluators who were blind to the class in which each student was enrolled should have graded the papers. However, reports have been returned to the students, and it is now too late to reevaluate them. Nevertheless, in defense of the procedure, in 1979 and 1980 I had not even considered using multiple drafts and did not anticipate that I would be using the lab grades for any research purposes. Also, in 1981 and 1982, I did not consider comparing the grades to previous ones until after all the reports had been graded and returned to the students. My impression, therefore, for whatever it is worth, is that the grades are equitable, and there seems to be at least some indication that students show higher quality work more quickly when multiple drafting is used. The results seem well worth the time and effort of both faculty and students.

Conclusions

The main point of this chapter is that scientists, like writers in all other disciplines, benefit from understanding writing as a process. Revision is just as important for the researcher reporting scientific information to an audience of peers as it is for the poet or novelist writing for the general public. Students in scientific disciplines can develop a "flair" for accurate, concise, and clear writing as well as students in English can. Furthermore, they will find that their thoughts and ideas develop and become better focused in the process. Emphasis on the prevision, vision, and revision of laboratory reports can yield immense benefits for the students.

Donald Murray (1978) reports an anecdote about a colleague, a philosophy professor, who confessed to be embarrassed that he often didn't know what he wanted to say or how to go about saying it when he sat down to write. It was during the process of writing that his thoughts gradually become clearer and insights developed. Only after talking to Murray did he come to learn that his behavior was normal. I suspect that the students who responded on the questionnaire that writing allowed them to develop new insights into the material experienced the same awakening as did Murray's colleague.

I was not surprised by the outcome of the questionnaire. I fully expected that the students would be nearly unanimous in their praise of multiple drafting. I further suspect that many of the students took more from the course as a result of their experience with multiple drafts. They hopefully gained a better appreciation of the importance of writing in the development and clarification of their thoughts. They may even be better scientists as a result.

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